

**U.S. EPA REGION 10 Office of Environmental Assessment  
Field Standard Operating Procedure**


**Title:** Optical Gas Imaging with a FLIR GF320 Infrared Camera

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## 1. Scope and Application

This standard operating procedure (SOP) is a general guide to the use of the FLIR GF320 infrared gas imaging camera. For more complete information, please consult the manufacturer's User's Manual as referenced in this document, or attend training on the use of this instrument.

This document contains direction developed solely to provide internal guidance to U.S. Environmental Protection Agency (EPA) personnel. EPA retains the discretion to adopt approaches that differ from these procedures on a case-by-case basis. The procedures set forth do not create any rights, substantive or procedural, enforceable at law by a party to litigation with EPA or the United States.

The GF320 is used to detect the emissions of volatile organic compounds (VOC) invisible to the naked eye and can also measure temperatures between -40 °C and 350 °C with  $\pm 1$  °C accuracy. Detectable gases include:

- Benzene
- Ethanol
- Ethylbenzene
- Heptane
- Hexane
- Isoprene
- Methanol
- MEK
- MIBK
- Octane
- Pentane
- 1-Pentane
- Toluene
- Xylene
- Butane
- Ethane
- Methane
- Propane
- Ethylene
- Propylene

## 2. Summary of Method

The GF320 camera provides real-time visualization of gas leaks and is used in the field to assist in leak detection and repair (LDAR) inspections, reconnaissance investigations, and mobile monitoring to detect and record VOC emissions in a multitude of industries. The camera can be used to locate leaks of volatile organic compounds from nearly all potential sources, such as

valves, pumps, compressors, tanks, pipelines, barges, etc, and also to view tank/container contents by the indication of temperature differences. The camera does not provide quantification or speciation of VOC emissions. The use of gas detectors such as the PhoCheck Tiger Photoionization Detector (PID) is necessary for quantification of emissions. Speciation of emissions requires process knowledge regarding the organic gas observed or an analyzer with this capability.

The GF320 is designed to identify emissions of hydrocarbon gases through the use of an infrared detector. The detector has been designed to capture infrared radiation emitted within a narrow infrared spectral range corresponding to several hydrocarbon gases. The images of these hydrocarbon emissions, which appear as either “black smoke” or “white smoke” depending on polarity settings, are displayed in a viewfinder in real-time. Detection of smaller leaks can often be obtained using the manual or high sensitivity modes on the unit. Operators should be familiar with these operating modes prior to use in the field.

### **3. Health and Safety Warnings**

- 3.1 This document does not attempt to address all the safety problems associated with the use of the infrared cameras. It is the responsibility of the user of this standard procedure to establish appropriate safety and health practices. Always observe proper safety procedures when using an infrared camera.
- 3.2 When working with potentially hazardous materials or situations, follow EPA, OSHA, and specific health or safety procedures.
- 3.3 All proper personal protection clothing and equipment is to be worn.
- 3.4 Compounds detected by this method may be irritating or corrosive to tissue, toxic, or fire hazards.
- 3.5 To prevent overstrain injuries, hold the camera in an ergonomically correct position and adjust the viewfinder, display angle, and camera grip to fit your work position.
- 3.6 The laser pointer can cause eye irritation. Never look directly into the laser beam or point the laser at anyone.
- 3.7 The use of the FLIR GF320 does not give EPA personnel authority to enter confined spaces. EPA personnel are not to enter any known or potential confined spaces.
- 3.8 Before using the GF320, EPA personnel should read the warning and cautions section of the latest FLIR GF series user manual.
- 3.9 Avoid walking while using the camera whenever possible.

### **4. Interferences**

- 4.1 Using the camera in furnace or other high-temperature applications without a heat shield (sold separately) can cause damage to the camera. Follow the procedure given in the latest FLIR GF series user manual for details on mounting the heat shield.

- 4.2 Gas leaks can be more difficult to see in still images than during live image mode.
- 4.3 Using the GF320 to detect VOC emissions is a combination of science and technique. Various VOC compounds and environmental conditions can obscure gas leaks. Different techniques and camera settings should be tried to obtain the best possible data or image during an inspection.

## **5. Personnel Qualifications**

- 5.1 For each deployment of the FLIR GF320 for fieldwork, personnel handling the camera should include at least one staff member who has successfully completed training on Optical Gas Imaging within the preceding five years. If the staff member has not used the camera within the preceding two years, an informal refresher training session is advised with personnel who have more recently deployed the camera in the field.
- 5.2 Staff members using the camera should be competent and fully understand the operation and care of the FLIR GF320 before using. Before use, operator should ensure that the instrument is working properly. Instruments not working properly, as identified by the operator or custodian, should be sent to the manufacturer for the appropriate maintenance.
- 5.3 All personnel shall be responsible for complying with all quality assurance/quality control requirements that pertain to their organizational/technical function.

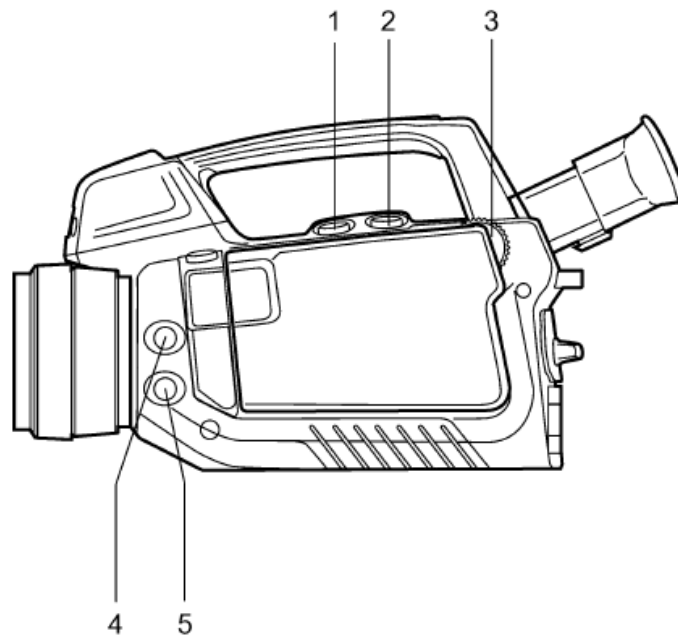
## **6. Equipment and Supplies**

### **6.1 *Equipment List***

- Hard transport case
- Infrared camera
- Lens cap
- Shoulder strap
- SD Memory card
- Telephoto lens
- Battery charger and two batteries
- Power supply
- USB cable
- HDMI-DVI cable
- HDMI-HDMI cable
- FLIR VideoReport™ PC software CD-ROM
- User documentation CD-ROM
- Calibration certificate
- Printed Getting Started Guide and Important Information Guide
- Hard copy of this SOP.

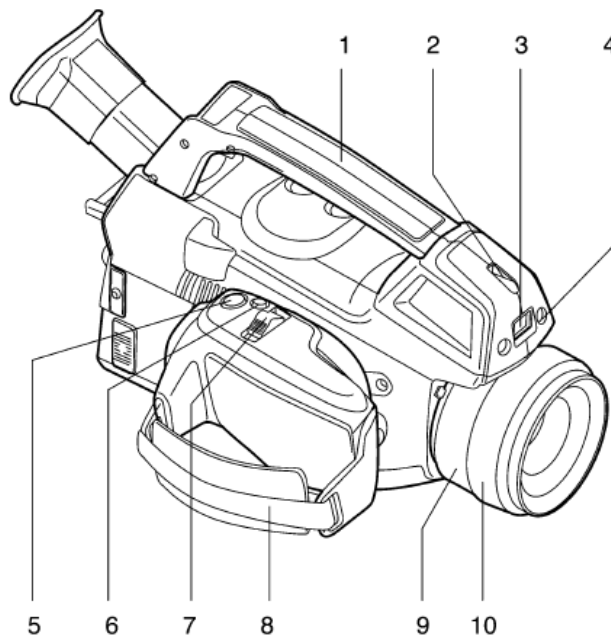
## 6.2 *FLIR GF320 camera features and controls*



### 6.2.1 Camera body: view from left



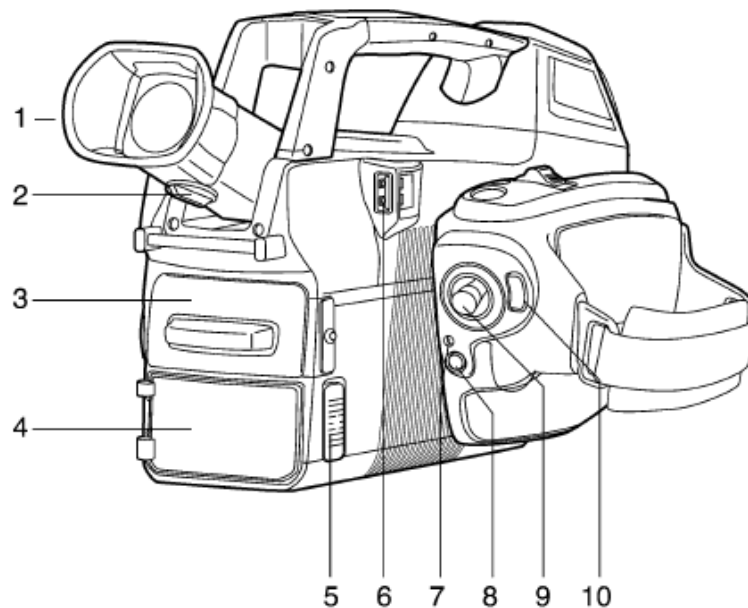
- 1 Programmable button (programmed in **Setup** mode), options:
  - Change zoom factor
  - Show/hide graphics
  - Change polarity
  - Change color palette
- 2 Temperature range button
- 3 Mode wheel:
  - **Camera** mode: save images
  - **Video** mode: record video clips and video sequences
  - **Archive** mode: view saved images, videos clips, and video sequences
  - **Program** mode: set up periodical saving of images
  - **Setup** mode: change several settings
- 4 Laser button
- 5 Button to switch between infrared mode and digital camera visible light mode



### 6.2.2 Camera body: view from right



- 1 Camera handle
- 2 Laser pointer
- 3 Digital video visible light camera
- 4 Digital camera lamps: in camera mode, turn on the lamps by pushing the joystick
- 5  button (Preview/Save): to preview image, press and release button. To save image without previewing, press and hold button for more than one second.
- 6 **A/M** button: press and release to change image adjustment method (Auto, manual, High Sensitivity Mode); press and hold to calibrate the camera with the lens cap on.
- 7  button: in live mode, push button left/right to focus, press center of the button to autofocus. In image preview or saved mode, push button left/right to zoom.
- 8 Hand strap
- 9 Focus ring on infrared lens
- 10 Infrared lens

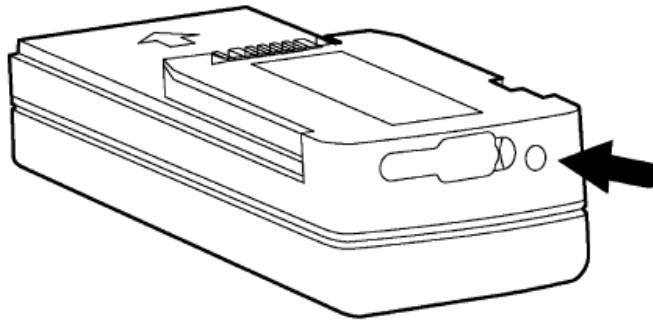
### 6.2.3 Camera body: view from rear



- 1 Viewfinder
- 2 Adjustment knob for viewfinder's dioptic correction (focus)
- 3 Cover for connector compartment
- 4 Cover for battery compartment
- 5 Release button for battery compartment cover
- 6 USB-A connector for external USB devices
- 7 Power LED indicator
- 8  button (On/Off): press and release to turn on; press and hold for two seconds to turn off
- 9 Joystick: move up/down/left/right to navigate menus and change values; press the joystick to confirm choices
- 10  button: Menu/Back



#### 6.2.4 Battery Condition LED Indicator



- Green LED flashing: battery is charging.
- Green LED continuous glow: battery is charged.
- Green LED off: power supply or stand-alone battery charger is disconnected from battery.


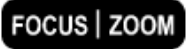


### 7. General Camera Operation: Detecting Temperature and Gas Leaks

#### 7.1 Camera start-up


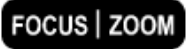
- 7.1.1 Ensure that a fully charged battery has been inserted into camera.
- 7.1.2 Turn power on and allow about 7 minutes for camera to reach operating temperature. The message in the viewfinder will read “Cooldown in progress” during this time.
- 7.1.3 After cool down is complete, verify that date and time settings are correct.
- 7.1.4 Perform a NUC (non-uniformity correction). With the lens cap on, hold down the A/M button for 1 second. If you have performed a NUC with the lens cap off, a ghost image will appear on your viewing screen. In this event, place the lens cap back on and hold down the A/M button for 1 second to re-do a NUC.
- 7.1.5 Remove lens cap and select AUTO, MANUAL, or HSM (high sensitivity) mode.
  - 7.1.5.1 In the AUTO mode, the camera sets the level and gain based on scene content, which can also be described as the temperature of the objects in the scene.
  - 7.1.5.2 In the MANUAL mode, the user adjusts the level and gain manually to optimize the image in the viewfinder.
  - 7.1.5.3 In the HSM mode, level and gain are set by the camera along with a higher image integration rate to allow imaging of smaller leaks.
- 7.1.6 Adjust the focus using the FOCUS/ZOOM button to produce the clearest thermal image.

- 7.1.7 Ensure that the camera is functioning properly (operation verification) by viewing the presence of a hydrocarbon plume through the eyepiece. This can be accomplished by the use of a butane lighter or other hydrocarbon source. **Save an image or video of the hydrocarbon plume as a demonstration of instrument operability on the day of use and keep this image or video in the case file.**
- 7.1.8 Camera is now ready for thermal imaging.
- 7.1.9 Users should refer to the operating manual for more information on keypad and button functions, level/gain controls, and thermal image recording.


## 7.2 *Detecting a temperature*

- 7.2.1 Turn mode wheel to camera mode ()
- 7.2.2 For furnace or other high-temperature applications, mount the heat shield and enter the correct external optics transmission value in the **Edit** tab. Reset the external optics transmission to 1.0 when the heat shield is removed.
- 7.2.3 Push the temperature range button. Choose a suitable temperature range by moving the joystick up or down, and push the temperature range to confirm.
- 7.2.4 Aim the camera toward the object of interest and autofocus by pushing the center of the  button.
- 7.2.5 Press the  button (Menu) and move the joystick left/right to the **Edit** tab. Select **Add spot** and push the joystick in. A spot meter is now displayed in the middle of the screen and temperature is displayed in the result table in the top left corner of the screen.
- 7.2.6 To save an image, press and hold the  button for more than one second.
- 7.2.7 To move the image to a computer, either remove the memory card and insert it in a card reader connected to a computer, or connect the camera to a computer using a USB mini-B cable.

## 7.3 *Detecting a gas leak*

- 7.3.1 Turn mode wheel to video mode ()
- 7.3.2 Push the temperature range button. Choose a suitable temperature range by moving the joystick up or down, and push the temperature range to confirm.
- 7.3.3 Aim the camera toward the object of interest and autofocus by pushing the center of the  button. Detectable gas leaks will be visible on the screen and will resemble smoke plumes emanating from the source of the leak. If the image is of poor quality, improvements can be made through adjustments of the temperature range, color

palette, and the use of histogram mode. For further details, consult the FLIR GF Series User's Manual Chapter 13: Achieving a good image.

- 7.3.4 To start and stop recording, push the  button.
- 7.3.5 To move the image to a computer, either remove the memory card and insert it in a card reader connected to a computer, or connect the camera to a computer using a USB mini-B cable.

#### 7.4 *Adjustments and advanced use*

- 7.4.1 See Chapter 17 of the User's Manual for further information on working with measurement tools.
- 7.4.2 Follow the procedure in Chapter 18 of the User's Manual to program the camera for automatic periodic saving of images.

### 8. Data and Records Management

- 8.1 All data and information is to follow applicable records management SOP's.
- 8.2 Field monitoring data should be recorded in the site specific log book for the project.
- 8.3 Images and video clips that are saved during an inspection are stored on a memory card to be transferred to a computer upon return to the office.
- 8.4 All images and video are to follow applicable policies and procedures.

### 9. References

- 9.1 FLIR Systems. FLIR GF Series Getting Started Guide. Revision 014. February 12, 2014. Hard copy available in camera case.
- 9.2 FLIR Systems. FLIR GF Series Brochure. Electronic version available at: [http://www.flir.com/uploadedFiles/Thermography\\_USA/Products/Product\\_Literature/flir-gf-series-brochure.pdf](http://www.flir.com/uploadedFiles/Thermography_USA/Products/Product_Literature/flir-gf-series-brochure.pdf)
- 9.3 Optical Gas Imaging, a Course for Users of the Gasfindir and GF Series Infrared Cameras. Infrared Training Center, Pub 111L 2014-11-24. Distributed to attendees at FLIR Optical Gas Imaging classroom training.

### 10. Change History